

Structure, Identities and Modeling with Equations

Grade 11 – Algebra 2 math · Worksheet · Standards: A-SSE.A.1, A-SSE.A.2, A-CED.A.1, A-CED.A.2, A-CED.A.3, A-CED.A.4, A-REI.D.11, A-APR.C.5, N-CN.C.8, N-CN.C.9

Name: _____ Date: _____ Class: _____

These problems train rewriting expressions with structure, the Binomial Theorem, complex factoring, creating equations and inequalities, rearranging formulas and solving $f(x) = g(x)$, matching standards A-SSE.A, A-CED.A, A-REI.D.11, A-APR.C.5 and N-CN.C.

Early problems drill one technique at a time. Later ones build models for gardens, cars, mixtures and budgets.

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Problem 1 Interpret a model (easy)

The value of a savings account is $A = 500(1.04)^t$, where t is years. Explain what 500 and 1.04 mean.

Problem 2 Difference of squares twice (easy)

Factor $x^4 - 625$ completely over the real numbers.

Problem 3 Factor with a coefficient (easy)

Factor $16x^4 - 81$ completely over the real numbers.

Problem 4 Rearrange a volume formula (easy)

The volume of a cone is $V = (1/3)\pi r^2 h$. Solve for h .

Problem 5 Rearrange a trapezoid area formula (medium)

A designer knows the area A , the height h and one base b_1 of a trapezoid and needs the other base. Rewrite $A = (1/2)h(b_1 + b_2)$ with b_2 alone on one side.

Problem 6 Expand with Pascal's triangle (medium)

Use row 4 of Pascal's triangle to expand $(x + 2)^4$.

n = 0						1								
n = 1						1		1						
n = 2						1		2		1				
n = 3						1		3		3		1		
n = 4						1		?		?		?		1

Rows 0 to 4; the middle of row 4 is missing.

Problem 7 Expand with a negative term (medium)

Expand $(2x - 1)^3$.

Problem 8 A single coefficient (medium)

In the expansion of $(x + 2)^6$, which term contains x^2 , and what is its coefficient?

Problem 9 Factor over the complex numbers (medium)

Factor $x^2 + 25$ over the complex numbers and verify by multiplying.

Problem 10 Zeros and factors of a quadratic (medium)

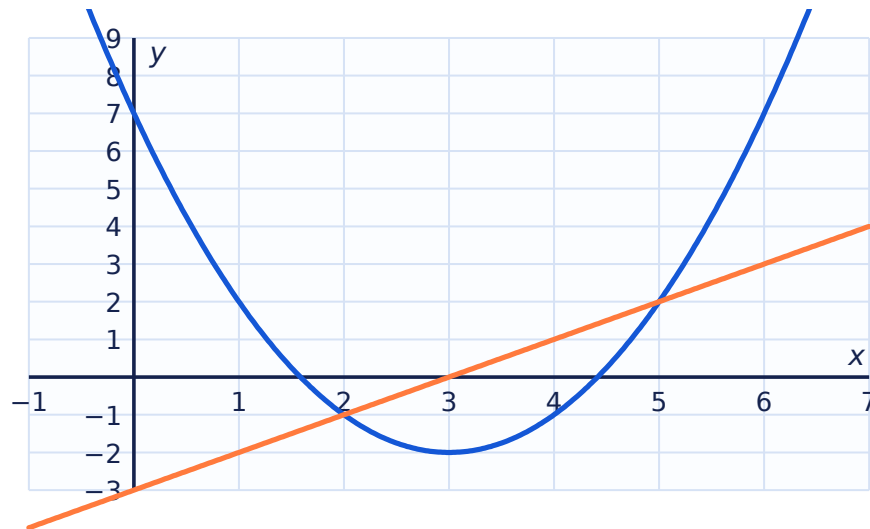
Find the zeros of $x^2 - 4x + 13$ and write it as a product of linear factors.

Problem 11 Generate a Pythagorean triple (medium)

Verify the identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ by expanding, then use $x = 4$ and $y = 1$ to find a triple.

Problem 12 Solve $f(x) = g(x)$ from a graph (medium)

A parabola $f(x) = x^2 - 6x + 7$ and a line $g(x) = x - 3$ are sketched below. Use the sketch to estimate where the two outputs are equal, then verify by solving an equation.



Problem 13 Solve with a table (medium)

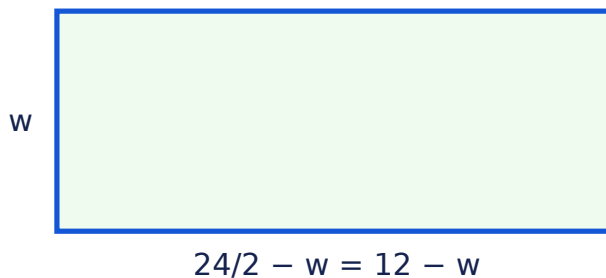
Ravi tabulated two models, $f(x) = x^2 + 6$ and $g(x) = 5x$. Scan the table for the inputs that give identical outputs.

x	0	1	2	3	4	5
$x^2 + 6$	6	7	10	15	22	31
$5x$	0	5	10	15	20	25

Values of $x^2 + 6$ and $5x$.

Problem 14 Garden constraint (hard)

A rectangular garden has a perimeter of 24 feet and an area of at least 20 square feet. If the width is w , write an inequality in w and find the possible widths.



Garden with perimeter 24 ft.

Problem 15 Depreciation model (hard)

A car worth \$24,000 loses 12% of its value each year. Write $V(t)$ and find when its value reaches \$15,000, to the nearest tenth of a year.

Problem 16 Mixture as a rational equation (hard)

A tank holds 20 liters of a 20% acid solution. How many liters of pure acid must be added to reach a 50% solution? The concentration after adding x liters is $(4 + x)/(20 + x)$.

Problem 17 Ticket sales system (hard)

A school play sold 150 tickets for \$1,330. Adult tickets cost \$12 and child tickets cost \$7. How many of each were sold?

Problem 18 Budget constraints (hard)

Jada has \$60 to spend on notebooks at \$4 each and pens at \$1.50 each, and she needs at least 6 notebooks. Write the system of inequalities and test whether 6 notebooks and 20 pens is

allowed.

Problem 19 Binomial Theorem with complex numbers (hard)

Use Pascal's triangle to compute $(1 + i)^4$.

Problem 20 Identities for mental arithmetic (hard)

Use $x^4 - y^4 = (x^2 + y^2)(x + y)(x - y)$ to compute $12^4 - 5^4$ without finding each fourth power.